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SAFETY STANDARDS AND SAFETY SUGGESTIONS AT IRON MINES IN THE LAKE SUPERIOR REGION

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BY

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SAFETY STANDARDS AND SAFETY SUGGESTIONS AT IRON MINES IN THE LAKE SUPERIOR REGION[1]

By F. S. Crawford[2]

INTRODUCTION

Although it may be impracticable to adopt standard methods of safe working in all branches of mining, and although it may be impossible to establish a standard for each class of work at each mine, some of the iron-mining companies in the Lake Superior district have found that by adopting certain standard ways of performing certain of their operations they insure both more efficient and safer working conditions. Many companies have adopted the idea that the safe way of doing things is also the most efficient and economical way, and, through the medium of their safety conferences they are trying to find the safest way, and the most efficient way, of performing practically every operation about the mines.

This activity will, undoubtedly, be continued at every operation which uses this method of doing safety work, because in the advance of industry changes must be made in the results required from time to time.

A review of the safety standards and safety suggestions which have been arrived at by some of the companies in this the greatest iron-mining district in the world, will be of value to companies who are interested in improving the safety of their working conditions.

So that attention may be directed to the methods in use, rather than to individual companies, all names have been omitted and companies are referred to only by letter.

COMPANY A

Drifting

In all timbered drifts the company has adopted forepoling as a standard safe practice. This consists of placing two rails about 12 feet long over the caps and blocking the rails on the end. Lagging is placed across the rails in the back of the drift. It is the company's practice to gunite rock drifts. In all main levels a safety zone or shelter hole is cut in the side of the drifts at 100-foot intervals.

Raising

All raises are driven double and cribbed with 5-foot round cribbing timber. One compartment is used as a ladder road and the other for ore or rock. In some cases when driving a raise, one side is driven up first. It is blasted and then cribbed and the back blocked over. Then the other side is driven up. This method is used where the nature of the ground is such that it would be hazardous to work the full width of the raise at one time. Headboards are also used in raises, and in some cases the entire back of the raise is lagged over before drilling. The ground is then drilled through the lagging. Eight-foot ladders are found relatively easy to handle in the subdrifts and to change if they get broken or worn out. All raises are equipped with a raise door and with a timber hoist and timber cradle to handle timber and other supplies. A bar or gate is placed at the bottom of the raise to prevent men from stepping backwards onto the track and thus be in danger of being struck by cars or motors. With this bar in the way a man must turn around and face the track and then he can see the cars or motors approaching.

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[1] - The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6510."

[2] - District engineer, U. S. Bureau of Mines Safety Station, Duluth, Minn.

All chutes are equipped with trolley wire guards. Baffle plates are installed at the mouth of chutes to prevent the trammers or chute tenders from being struck by chunks rolling out of the chute. Since installing this baffle plate the company reports that it has had no accidents to fingers or toes. All chutes are equipped with blow pipes to be used in loading the motor cars. When the blow pipe is found to be ineffective, the ordinary chute bar is used.

BLASTING

Blasting is done with both fuse and electricity. All approaches to the place being blasted must be guarded. Explosive is transported to the working places in bags provided for that purpose. Fuse and detonators are transported in containers. In all working places the explosive, fuse and detonators must be at least 25 feet apart; they are not allowed to be left lying around or on the ground. When making up primers for blasting, a miner is required to take his carbide lamp out of his hat and place it on the side of the drift at least 5 feet away. Lacing the fuse through the explosive is not permitted. Detonators must be inserted either at the end of the stick of explosive or in the side and the fuse must be fastened down with a string. All miners are furnished with a copper powder punch which is used to make a hole in the stick of explosive to allow insertion of the detonator.

Electric Blasting

When blasting is done electrically, the explosive, or electric detonator, can not be taken into the breast of the drift while the current is on the trolley wire. Holes can not be charged until all machines, drills, and equipment have been removed from the place. A sectionalizing switch must be installed in all places where electricity is used for blasting purposes. Before charging holes, all electric current must be shut off from the drift by opening this section switch. The man in charge of blasting must be stationed at this switch until the blasting is completed. Before charging holes, jumper switches must be in place and a blank igniter placed across the end of the blasting lines. The lead wires for the electric blasting must not be allowed to touch the ground or come in contact with rails or pipe lines. Blasting boxes must be kept locked until ready to blast; one man has charge of the key of the blasting box. All bottom holes must have two exploders. The lead wires must never be wound around spikes to keep them off the ground; insulators must be used, or if it is impossible to use insulators, wooden sprags should be employed to support the lead wires. These rules are strictly enforced in all electric-blasting operations.

Fire Fighting

Apparatus for fire-fighting purposes is as follows: 5 self-contained, mine rescue, breathing apparatus; 4 All-Service gas masks; and 7 self-rescuers, with a goodly supply of oxygen, regenerators, canisters, and other supplies. There is a fire pump underground which is connected to the pump-house sump. In case of fire, the air can be shut off and water introduced into the air lines. In all main-level drifts a 1½-inch fire connection is made in the air lines at every 200 feet. On every shaft station 100 feet of 1½-inch fire hose is kept for fire-fighting purposes only. For fire in the "subs" the regular hose which the miners use for drilling is available. Fire extinguishers are kept underground at all points where they can be readily reached. Two All-Service gas masks are kept in the pump room for emergency.

Standard Safe Practices of Company A

The following is a copy of Standard Safe Practices which are in force at the A mining company:

General

Safety signs indicating the direction of travel to the different exits or shafts must be maintained, and these passageways must be kept open.

All employees, both surface and underground, must be equipped with goggles.

No tobacco cans are allowed to be used as carbide containers, and regular carbide containers must be used to carry the supply of carbide for the shift.

Safety belts must be worn whenever there is danger of a man falling away.

When men are working in the shaft, there must be a sign put up at every station and on surface, reading "DANGER - Men working in Shaft."

Riding on running board of cars or trucks is strictly forbidden.

A safety jenny must be used in erecting all trestles.

An All-Service gas mask should be used when working around chlorine apparatus at the water plant.

There shall be a steel box installed on the landing to keep straw or hay in.

All emery wheels shall be equipped with the Perks Safety Washer.

In steam-shovel work, the shovel operator must blow a warning signal before moving dipper whenever it has been stopped either for cleaning up or when moving ahead.

In welding or cutting it is not permissible to use any open lights around the acetylene tanks.

All empty carbide cans must be washed out with water as soon as they are emptied.

Handling Timber

Timber cradles must be used in all permanent timber raises.

Timber, lagging, or tools must not be piled and left too close to the track.

Timbermen must not stand in bottom of raise while timber, lagging, or tools are being hoisted.

Timber, lagging, or tools must not be thrown down a raise unless someone is stationed at the bottom of the raise or sub to warn anyone that might be passing.

Timber and lagging must not be stored by the shaft.

Timber, lagging, and tools must not be pushed ahead of the motor, but must always be pulled by the motor.

At all raises where timber, lagging, and tools are being hoisted or lowered, there must be a red flashing light or flag used as a warning signal.

All persons handling timber, lagging, or tools must use good leather gloves or mitts.

All permanent timber raises must be equipped with a return bell signal.

Bell signal system must be used in all raises over 20 feet high.

Timbermen must keep the place around the hoisting compartment on every "sub" clean so that no material will be knocked down the raise while handling timber or tools.

Timbermen must make sure that the slings to which the blocks are hung are strong enough to carry the load.

Motor Haulage

Bell on motor must be sounded whenever the motor is started and on going around a curve.

No person shall ride on the cars or motor except motormen and swampers.

No materials to be carried on the motor.

All motor headlights to be kept clean and in good condition, and no motor shall run without headlights.

Motors must stop when men are walking out to the shaft at quitting time.

All motor trains must be equipped with tail bells.

Switching or dumping cars on the fly is forbidden.

Motormen must not run past the block signal safety light.

No one shall run motor unless authorized to do so.

No one shall attach a wire from motor to trolley wire in order to get motor cars out of a drift.

All motor haulage ways must be kept clean.

All chutes must be guarded with a baffle plate in the mouth of chute.

Trolley wire at chutes must be guarded so that it protects half of each car besides the one that is being loaded.

No one shall take dirt out of a chute unless the trolley wire is guarded.

The trolley wire over all pockets must be equipped with the Miami type of trolley guard.

Explosives

Powder must be kept at a safe distance from working place and hung up. Caps and fuse must be 25 feet away from powder.

Fuse and cap containers must be used in transporting fuse and caps from powder house to working place.

Shift boss must supervise all places where they are going to blast through into another place.

No powder boxes or spike kegs are allowed in working places.

Powder boxes that are needed must have the name of powderman written on the inside of box.

All blasting lines must be kept in good order. All blasting lines must be equipped with a single-pole knife switch as a short instead of wire. All current must be cut off trolley wire by a sectional switch before charging holes in a drift. Blasting box must be kept closed—locked.

The lamp must be taken out of the hat when making up the primers and put about 4 feet away.

Copper powder punches must be provided for every gang of miners.

Powder bags, fuse containers, and electric-fuse containers must be used for the transporting of powder and caps from powder house to working place.

No more than 6 inches must be cut from a 6-foot fuse when blasting in any drift or subdrift.

In all bottom holes, there must be two fuses.

All missed holes must be reported to the foreman.

No more than 10 holes to be lighted by one man.

Anyone lighting fuses must have an extra light in case the one he is using goes out.

In case of a missed hole, no one shall be allowed to enter the place for one-half hour.

Hoisting Men

No more than four men and cage tenders shall be allowed to ride on cage while skips are in motion.

Skips must stop when men are being hoisted at end of shift.

No one shall ride with timber, tools, trucks, or powder, excepting cage rider.

Hoist engine man must always give one bell whenever he stops at a level or surface.

A blocking device must be used on cages to prevent the timber truck from moving.

When men are working on skips or cages, a sign reading "Dont start, man working on skips" must be on display on the stand in engine house.

At all level stations a sign must be displayed reading "Do not ring unless cage is here."

Main Drifts

All main drifts must be kept clean and equipped with safety zones at every 100 feet.

All timbered drifts must be equipped with a fire connection every 200 feet and shall not be used for other purposes.

All ladder roads off main drift must be fixed so that a man can not step backwards onto the track.

Carbide Disposal

Carbide must not be dumped along the side of drift or any place where it can be seen.

Dump carbide in cars, pockets, raise, or tunnels where there is no running water.

No carbide shall be dumped on surface.

Mining

Chain and iron wedges are the standard adopted for slusher work.

All slusher hoists must be guarded.

All miners working with slushers must have a pair of good leather mitts or gloves.

All shift bosses and trammer bosses are required to make out a safety report at the end of each shift.

Safety belts must be used wherever there is danger of a man falling.

Signs indicating the direction to different exits must always be kept in good order.

Penalties for infringement of safety rules are to be administered through the operating heads.

In all drifts where timber is used, forepoles must be used.

In raising, ladders must be put in as soon as there is room for an 8-foot ladder.

In all raises over 100 feet high electric blasting must be used.

In raising, ladder must have a clearance of at least 4 inches.

All persons going underground must wear a hard boiled hat.

Use of Goggles

All underground employees shall be equipped with screen goggles, but in certain places it may be necessary to equip certain employees with Willson goggles on account of the dusty conditions.

Also, employees in the powder house shall be equipped with glass goggles. For blacksmith shop employees (except acetylene welding and grinding) King-Built or equivalent goggles shall be used.

Acetylene welding: Three types of goggles are used for the different kinds of welding. For the oxy-welding: the King-Built spectacle type of goggle or equivalent. For cutting: the Wellworth welding goggles, or equivalent. Also, a Hardy goggle with Universal glass is adapted to all sorts of acetylene welding.

Grinding and chipping in machine shop: King-Built sani-glass or equivalent.

Electric welding: Mask for operators and a shield for helpers, and in connection with this, employees using this equipment are hereby warned that they should also cover their hands with heavy gauntlet gloves and their necks and arms with cloth protection, as the rays of the electricity are very injurious to the skin.

Cleaning flues: King-Built goggle or equivalent.

Landers, chunk breakers, and pitmen: Screen, King-Built, or equivalent goggles.

Nozzle operator on gunite machines: Gas-tight goggles as manufactured by the Mine Safety Appliances Co., or equivalent.

Babbitting: Babbitting mask of approved make.

----------, Safety Engineer.

COMPANY B

The safety standards of Company B are in general made to conform with the requirements of the county mine inspector. There are no printed safety standards; everything is left to the discretion of the foremen and shift bosses.

A hose cart and equipment are available for surface fire fighting. There are no daily fire runs between shifts at this mine underground.

COMPANY C

Company C has not set up any specific safety standards for any of the work, nor has it any printed safety rules. All safety precautions are entirely up to the mining captain. Although no fire run is made between shifts, there is always one pumpman underground.

COMPANY D

As a result of safety meetings, a number of safety suggestions have been made and collected by Company D. A total of 677 recommendations were made by employees at the various properties in 1929. This serves to show the importance of having mine safety committees and holding regular monthly safety meetings of all employees. These safety suggestions are under the following classifications: Safety suggestions; sinking; drifting; miners driving raises; tramming; stope mining; top slicing; and open-pit shovel work.

Safety Suggestions

Clothing.-

1. Hard-boiled hat.
2. Good carbide lamp.
3. Extra carbide in can.
4. Tip cleaner.
5. Matches in waterproof match box.
6. Wire-mesh goggles.
7. Woolen underwear.
8. Woolen shirt.
9. Overalls with jacket tucked in.
10. Wool socks.
11. Boots with the hard toe, knee length if mining.
12. Gloves with leather palm.
13. Slicker if working place is wet.

Change House.-

1. No horseplay around change house.
2. No clothes should be placed in contact with radiators or steam pipes.
3. No open lights allowed in the dry.
4. No accumulation of old clothes in the locker.

5. Place refuse from dinner pails in receptacles furnished for that purpose.
6. Be careful with supply of carbide in the dry.

Going to Working Place.-

1. Do not crowd into the cage.
2. Only one light allowed on the cage.
3. No tools, powder, or caps allowed on the cage with men.
4. Signals to be given by boss or cage rider, only, when raising or lowering men.
5. See that cage door is closed and kept closed until release bell is heard at the station.
6. In carrying tools to working place, keep them off your shoulder, so as to avoid coming in contact with trolley line.
7. When a motor approaches, step in the nearest safety station and do not step out into the drift until you are sure it is clear.
8. Keep traveling roads clean.
9. Keep off ladders when tools are being hoisted, lowered, or carried through raises.
10. Loose or broken ladder rungs in main traveling roads should be reported to shift boss or mining captain at once.
11. Keep eyes open for loose in sides of raise, loose on the ladder rungs, and especially in back of sides at top of raise.
12. Keep all sollars clean.
13. Keep eyes open for loose back over traveling road to working place.
14. Stay with partner or guide until new man becomes familiar with the mine.
15. If light refuses to burn or any other evidences of gas are observed, return to the station immediately.

Sinking

1. Experienced shaft miners should be employed if possible, also a capable hoist man and bucket lander.
2. The miners should provide themselves with hard-boiled hats, hard-toed shoes, wire-mesh goggles, and gloves.
3. Good tools are essential to safe shaft sinking.
4. The landing station and engine room should be well lighted.
5. A nonspinning hoist rope should be used.
6. Clevises or safety hooks must be used on all buckets.
7. A cross-head should be provided with a suitable safety device which will effectually prevent the bucket from lowering in case the cross-head should stick in the runners.
8. No one should ride the skip or bucket unless same is equipped with safety catches and protecting roof.
9. When sinking, bucket must be stopped in the clear near the bottom and rung down when needed by the miners.

10. Every one must stand in the clear at the bottom when bucket or other material is being hoisted or lowered.
11. When tools, timber, or other materials are to be lowered or hoisted in bucket, they shall be securely fastened to the hoisting rope or bail of bucket.
12. During sinking, suitable signals must be provided so that signals can be given from the bottom of the shaft.
13. Standard hoist signals should be used, however small the job, and all men involved should be acquainted with them.
14. All necessary material should be kept near the job, in excess of of immediate need, especially in sinking through surface material.
15. A toe-board should be used around the collar of the shaft to prevent chunks and other material from being kicked down upon the workmen.
16. The workmen should be protected with suitable doors and these doors must be kept closed when bucket is being dumped.
17. While sinking, the collars of the shaft or winze should be guarded with substantial railings not less than 40 inches high, spaced far enough from opening to prevent any person from walking into shaft or being hit by falling chunks.
18. Excavated material should be dumped where it is impossible for it to slide back into the shaft.
19. All blasting in shafts must be done by firing electrically after a depth of 5 feet has been reached.
20. The following safety devices and safety methods should be used to fire electrically safely:
    A. Holes should be connected up in parallel when power is obtained from trolley, and in series when connected to firing machine.
    B. Prevent high resistance in circuit by scraping wire ends clean and making all joints tight.
    C. Do not untwist the wires of the shorted electric blasting cap until ready to connect them to the shot-firing cable.
    D. Test all multiple shot circuits with a galvanometer to insure against failures from high resistance or broken wires.
    E. Use only well-insulated firing cable and keep it dry.
    F. Suspend the firing cable over a dry board in center of shaft keeping it from coming in contact with timber, pipe lines, etc.
    G. Firing cable should be "shorted" on end where the short portable cable is inserted in the circuit.
    H. Use a short cable with proper electrical connections to insert in firing cable to complete the circuit. This cable is in possession of man doing the firing only.
    I. Use a spring knife switch which keeps the circuit open except when pressure is applied when firing.
    J. Switch should be enclosed and padlocked and key in possession of man doing the firing only.

K. A switch should be placed in the trolley line so that power can be cut off from shaft vicinity when ready to charge the holes.

L. In retreating from charged holes, always be certain that each section of the firing cable that you are about to connect to, is "shorted" before making connection, and then open the circuit nearer the charged holes.

21. The portion of the shaft which is not timbered should be well trimmed.
22. While cleaning up a cut after blasting, special care should be taken to see that there are no missed holes.
23. The bucket should not be so full that there is any possibility of chunks rolling off while it is being hoisted.
24. All timber longer than 6 feet must be lowered with a clevis.
25. Timber sets should be carried as close to the bottom of the shaft as found practicable.
26. Great care should be used in blocking shaft sets; a jar might loosen a poorly blocked set and the blocking spill down upon the workmen.
27. All boards, planks, loose rock, and other material must be removed from each set as completed.
28. The timber should also be cleaned and inspected after each blast.

Drifting

1. At the beginning of every shift, as miners walk in the drift, they should look for loose ground in the back and on the sides and if any loose is found, it should be trimmed or propped at once.
2. The back and sides of drift at breast should be trimmed after every blast.
3. If timber in the drift is being advanced, poles should be put from last set to the breast and blocked tightly, so that no loose can fall between the lagging.
4. Where timber is necessary, it should be erected, using staging planks not less than 2 inches thick, and the staging should be held up by safety chain hooks.
5. If muck is to be scraped, no man should stand so as to be hit by ropes or block should the eyebolt break or pull out.
6. As muck pile goes down, the breast and sides should be trimmed, and the miners should be on the lookout for missed holes. The captain and shift bosses should also be on the lookout for missed holes.
7. Never start drilling while any missed holes are present.
8. When using a bar for drilling, be sure that both footings are solid. Soft wood plank should be used to wedge against.
9. Use goggles when starting to drill in hard ground.
10. When blasting, have an extra light near by.
11. When two drifts are within 30 feet of holing through, the men should notify each other as to when they expect to fire.

12. One man should not attempt to light all the fuses alone at a breast of any size.
13. Guard entrance of drift so that no one may enter while charges are exploding.
14. Count all charges as they explode and report any missed holes to the foreman promptly.
15. The back and sides of all timbered drifts should be thoroughly lagged.

Miners Driving Raises

1. Never drill holes for blasting deeper than can be broken clean to the bottom. This should produce the least shattering effect on the face left, and falling chunks are not as prevalent as when the cut is poorly broken.
2. Green hardwood poles, 3 to 4½ inches in diameter, should be used for staging. Stagings should be spaced not over 4 feet apart. Good hitches should be picked for each pole. Cut hitches for stage poles down from the top and not up from the bottom. If ground is very hard, holes can be made with "pop" holes and light blasts. Staging planks should reach from wall to wall on opposite sides, and should be not less than 2 inches thick and should be examined for cracks.
3. The chain grizzly should be hung from poles not over 10 feet from the face of the raise, before drilling the new cut. When raises are proceeding from sublevel to sublevel above, they should be covered with semipermanent grizzlies at the last "sub" holed into.
4. When blasting, a man should be stationed at the bottom of the raise to furnish light or help to the man lighting the holes in case he should lose his light or slip. When holing through, drift above must be guarded and bottom of raise should be guarded during blasting. Raises going over 50 feet between levels or sublevels should be blasted electrically.
5. After blasting it is good practice to blow air into raise to clear it of gases. Always be alert and on the watch for gases in long or poorly ventilated raises. After the blast the back and sides of the raise should be trimmed before anything else is done. Broken or loose stage poles should be replaced at this time.
6. Good tools, such as axes and saws, are essential to safe raising; for the stage, poles and coverings should be cut to an exactness of measurements.
7. Wear goggles when drilling or trimming.
8. The foot of the raise machine should be reasonably sharp so as not to slip on the staging blank.
9. Ladders should be used in raising and as near the head as possible.
10. Raise miners should be especially careful in placing their tools so as not to jar them down when moving around or trimming.
11. Always have a rope for hoisting and lowering tools and staging.

Tramming

1. No one excepting the motorman and brakeman are allowed to ride the motor.
2. No one is allowed to operate a locomotive except the men employed for that purpose, or a man authorized to do so by mining captain.
3. Keep the top of the motor free of material of any kind. No tools or other equipment excepting tools belonging to the motor shall be carried on the motor.
4. Keep lights and bell on motor in perfect condition.
5. No material shall be piled close to the haulage ways. Do not allow timber, rails, plank, etc. to accumulate in the main drifts. Keep the drifts clean.
6. Do not put material of any kind in the safety zones.
7. All switches, frogs, and guard rails on main levels should be blocked so that it is not possible for a man to get his foot caught.
8. The trolley in front of each chute should either have a disconnecting switch or should be guarded with an inverted trough. These guards should be long enough so that a man standing on the coupling at either end of the car is still protected from the wire.
9. The bar used in poking into the chute should be pointed on one end only and the other end looped to form the handle.
10. Trolley pole must not be turned while in motion.
11. Trolley poles must project away from the direction of motion of s locomotive, except in cases where this is impossible and then the locomotive must be operated at slow speed and motorman should hold on to pole.
12. In passing over switches, motor must be stopped before motorman or brakeman leaves the motor to throw the switch.
13. Where practicable, in handling timber trucks with the motor, trucks should be pulled by motor rather than pushed. A long drawbar should be used in this connection.
14. When two or more motors are operating on the same track, suitable block signals should be used.
15. See that there is a light near each chute.
16. Use a bar or shovel in moving chunks on lip of chute or car.
17. Keep powder and caps at least 25 feet apart. Keep powder in bag or box and keep caps in metal containers.
18. Guard all approaches when blasting on grizzlies, in chute or drift.
19. See that all chunks are loaded properly so that they will not roll off of car when car is in motion.
20. Motorman should slow down his train when passing men in drift.
21. Motorman should report to electrician, mining captain or shift boss, any defective condition of the electrical equipment.
22. Brakeman should hold on to car with one hand and use a stick to make a link-and-pin coupling.
23. Coupling should be made where there is plenty of clearance in drift, and where the motorman can see the brakeman. If this can not be done, a third man should be present to give the motorman signals.

24. Trammers should report broken or burned out electric lights along drift to electrician, mining captain, or shift boss.
25. Remove trolley pole when motor is unattended.
26. Trammers especially should wear hard-toed boots.

Stope Mining

1. Inspect back closely for loose and watch for cracks or any other indication of weak bench.
2. Keep bench clean at all times.
3. In rigging up or taking down post and tightening or loosening nuts on arm, always stand so that you are facing the stope.
4. Do not let any part of hose hang over the edge of the bench.
5. All tools not in immediate use should be kept in subdrift well back from stope. Dull and sharp steel should be kept separate and racked.
6. Floor of subdrift should be kept clear of all tools, boards, and refuse to reduce the stumbling hazard.
7. Where mining with auger-type machines, safety belts should always be worn when drilling stope holes or uppers unless otherwise instructed by mining captain or foreman.
8. When drilling slice holes on a bench, drill top holes so as not to break more than 7 feet above the bench.
9. In transporting explosives to working place use canvas bag for dynamite and copper containers for caps and fuse such as are provided for this purpose.
10. Keep caps and dynamite at least 25 feet apart and off the floor of drift.
11. Never lace your fuse when making primer. Use string as illustrated in book of rules.
12. Never use a spike to make the hole in cartridge.
13. Smoking is prohibited when handling explosives.
14. Before charging the holes see that they are well cleaned out by the use of a blowpipe or scraper.
15. When inserting cartridge into the hole, see that the flat end of the cartridge is next to the tamping stick.
16. Cartridge should not be rammed too severely when tamping.
17. When ready to blast, be sure that all men in the stope are notified, and guard all approaches to the stope.
18. When shaking a hole do not recharge it at once but wait a sufficient length of time for it to cool.
19. Count all holes, and in case of a misfire, wait 30 minutes before investigating.
20. All missed holes should be reported to mining captain or shift boss as soon as eiscovered.
21. When coming off shift or moving from one sublevel to another, bar off the opening into the stope in which you were working.

Top Slicing

1. After each blast, pole ahead and make your place safe by carefully trimming the back, breast and sides as far as the dirt will permit. Continue to trim the breast and sides as you scrape the dirt away.
2. When the center of your dirt pile is scraped down, be sure to pick down all chunks lying on the dirt pile to prevent them from rolling down on your hands and feet.
3. When timbering be especially careful of large holes in the back. In order to be safe such a hole should be filled in some manner or securely blocked so that it can not fill unexpectedly and throw an excess weight on the slice timber.

   If the back is poor or not covered, be sure to put boards on top of the poles so as to cover the back tight, leaving no openings for chunks to fall through.
4. Look over the timbered part of your slice every day before you begin your day's work and if any of the sets need a prop, prop it up at once, or if a sprag is broken or knocked out, replace it at once. Also trim the sides or block them.
5. The entrance to your slice should be kept clean so that, if it should become necessary to leave your place in a hurry, you can do so without danger of falling down over any obstacles which would delay you.
6. Always keep grizzly poles over the dirt raise.
7. When timbering, always use your chain hooks to make your staging.
8. Always wear goggles when breaking chunks with a hammer.
9. Make a staging to stand on while drilling; this will prevent you from falling to the ground in case the drill steel should suddenly break off. It is also well to guard yourself with one hand to prevent yourself from falling when the steel breaks.

   (Refers to drilling with jackhammer machine)
10. When blasting, notify the miners above and below you and all others close by. After the holes are lit, guard your entrance so that nobody can enter. Count all the holes as they go off and if you do not hear them all, wait 30 minutes before going into the place.
11. When using axes or saws be careful not to cut yourself with them. When not using axes and saws and other tools put them away in a safe place so that when anyone passes by they will not get injured by them.

Open-Pit Shovel Work

1. New employees should be told of the dangers surrounding their work.
2. Never lose an opportunity of repairing or reporting unsafe conditions or practices.
3. Strains and overexertions are serious. Use judgment in lifting or moving heavy objects.

4. Never throw tools or material to men working on boom, and do not leave tools or material on boom when through repairing.
5. When working on boom, keep in mind the injury to men below by falling of tools and material.
6. When working in high places, wear a life belt properly secured to prevent falling.
7. Pitmen should stay away from bank side as much as possible.
8. Tools should be placed on shelf under running board on track side of shovel.
9. Do not use wedges with mushroomed heads.
10. No lumber, boards or timber with projecting nails must be left lying where the nails can be trod on.
11. Nothing shall be piled closer than 8 feet from the center of the track.
12. Wear goggles when breaking chunks.
13. Watch out for chunks falling off cars or rolling down bank.
14. Chunks should be loaded on the cars properly and banks in vicinity of shovel must be kept trimmed at all times.
15. Pitmen should stay off the shovel, especially when shovel is working.
16. Keep chunks and other material from path used by pitmen when moving track sections ahead.
17. Keep your mind on your work so as to avoid dropping material on feet and hands and being pinched or crushed.
18. See that the coaling plank is in good condition and that it is supported firmly at both ends.
19. Never climb through, over, under, or between ore or stripping cars. Wait until the train passes or walk around the end of the train, giving yourself plenty of room for safety.
20. Do not climb on moving equipment.
21. The bucket should be set down on firm ground before doing any repairing, oiling, or greasing on boom engine.
22. Shut the shovel down before doing any cleaning, oiling, greasing, adjusting, or anything else which would cause you to be near moving machinery.
23. Always replace the guards before working the shovel.
24. Never stand or walk under bucket of shovel when the shovel is in operation.
25. Always be sure that the shovel runner sees you when going into the pit in front of shovel.
26. When you are on top of the bank in front of the shovel, never stand in line with the chain on the boom when the shovel is working, as the chain may break and strike you.
27. When pinching wheels, use a long stick so as to avoid being under the running board or the beam of shovel.
28. The shovel runner must be notified when the brakeman is inside the car breaking chunks.
29. Locomotive firemen must be sure that no pitmen or others are near the locomotive when sweeping gangway.
30. Before opening blow-off valve,. the fireman or any others should see that no one is in direct line with the blow-off.

COMPANY E

Company E has no standard methods of doing all operations because local conditions vary the requirements. However, a set of standards has been drawn up at their conferences through which they endeavor to set safety standards for various general classes of work. Those that have been covered are standards for the handling and use of explosives, and safety standards for the operation of scrapers, as follows:

Safety Standards for the Operation of Scrapers

1. Before starting operations the scraper hoist shall be lined up properly and spragged securely.
2. Before making repairs or adjustments on scraper equipment the power must be shut off.
3. Riding scrapers is prohibited.
4. Sufficient positions shall be used in setting up the head block at the breast of the drift so that it will not be necessary to handle the scrapers.
5. Sheaves for head and snatch blocks shall be 6 inches or larger in diameter. They shall be examined daily by the miners and frequently by the shift bosses, to make sure that they are maintained in good condition.
6. When there is a long pull as in transfer drifts or around corners, a device shall be provided for giving signals to the scraper hoist operator.
7. Lights shall be installed over the scraper hoist and an extension cord provided for lighting the drift where necessary.
8. The operator shall not move the scraper at any time until, or unless, he has a definite understanding with his partner.
9. Chains less than 1/2 inch in size shall not be used in the operation of scrapers.
10. When scraper is being operated, standing near the breast of the drift or in a direct line between the scraper hoist and head block is prohibited.
11. When handling wire rope, men shall be required to wear leather gloves.

Standards for the Handling and Use of Explosives

Surface Magazines.-

1. A surface magazine shall be located not less than 300 feet distant from a public highway, shaft, or building, and shall be in a protected place. All brush and inflammable material shall be cleared away for a reasonable distance.
2. The magazine shall be constructed of fireproof and bulletproof material and shall have a steel door equipped with a suitable lock. Adequate ventilation shall be provided. A lightning rod shall be erected at least 18 feet away from the building and shall rise at least 6 feet above the highest point of the building and be grounded in moist earth.

3. Detonators shall not be stored in the same building with dynamite or blasting powder.
4. Magazines must be kept clean at all times, and nothing except explosives shall be stored therein.
5. Boxes of dynamite or cans of powder must not be opened in a magazine.
6. Danger warning signs shall be posted at each magazine.

Transfer of Explosives.-

1. Not more than a 3 days supply of powder shall be taken underground at one time.
2. Powder delivered at a shaft shall be taken underground without unnecessary delay. If this is impossible, it shall be stored in a properly constructed building or covered with a tarpaulin.
3. Explosives shall not be loaded on trucks, skips, cages or cars with men, supplies, or machinery, except such men as may be required to handle them.
4. Explosives shall not be left temporarily at a shaft station, but must be removed immediately to a safe place designated for this purpose.
5. If trucks are used on surface or underground for carrying explosives, they shall be specially constructed for this purpose.
6. Explosives shall not be transported in a car next to an electric locomotive or in any car hauled by a gasoline locomotive.
7. When miners transport explosives, they must be carried in the original containers or in jute bags.

Underground Storage of Explosives.-

1. An underground magazine shall be located in a separate drift or chamber, the walls of which must be fireproof, and shall be located at a safe distance from shafts, pump stations, and main travelled drifts.
2. An underground magazine shall be dry and well ventilated.
3. A powder magazine shall not be directly connected with dry timbering. There shall be a space of at least 10 feet between the magazine and the nearest set of timber.
4. A magazine shall be kept locked when attendant is not on duty.
5. Magazine shall be lighted from the outside if possible. Properly installed electric lights, however, are permissible.
6. Open lights shall never be allowed in a powder magazine.
7. Only one days supply of powder from a magazine shall be given out to each gang, which must be carried in a jute bag.
8. A hardwood mallet and wedge shall be used in opening powder boxes.
9. In mines not using underground magazines, dynamite shall be stored in boxes provided with locks.
10. Care must be taken in placing powder supplies, so as not to endanger main haulage drifts or passageways.
11. Powder supplies must not be placed near live electric wires.

Cutting and Capping Fuses.-

1. All fuses shall be cut and capped, at a suitable place provided for this purpose, by an employee designated for this work.
2. The fuse cutting and capping station shall be located at least 50 feet from a dynamite magazine.
3. Only an approved bench-type fuse cutter and cap crimper shall be used.
4. Capped fuses shall be carried in lined metal containers, and they must be kept in these containers until used.
5. The minimum lengths of fuse shall be as follows: for block holes 3 feet, for drifts 5 feet, for raises 6 feet.
6. Only a standard compound or cap seal shall be used for waterproofing a fuse.

Blasting.-

1. A copper or wood skewer shall be used for punching holes in primers.
2. Open lights must be removed from hats and placed at a safe distance while primers are being prepared.
3. Drill holes shall be thoroughly cleaned out with a scraper or blown out with compressed air before being charged.
4. Charging shall be done only by men experienced in this kind of work.
5. Wooden tamping bars shall be used and the tamping shall be done by pressure only.
6. Tamping material shall be used in all dry holes.
7. Loose powder must be left nowhere except in bags or boxes.
8. Miners about to fire shots shall cause warnings to be given in every direction, and all entrances to the place or places where charges are to be fired, shall be guarded while such firing is going on.
9. The number of shots exploding, except in the case of electric firing, shall be counted by the miner in charge of the blast.
10. In shaft sinking, shots shall be fired by electricity.
11. If a miner is uncertain that all the shots have exploded, no one shall be permitted to enter the place where such charges were fired for a period of 30 minutes.
12. Miners shall not extract explosives from a hole that has missed fire, but a fresh primer shall be inserted above the missed explosive and fired.
13. When tight tamping or stemming is used or when for any reason a new primer can not be inserted, a new hole shall be drilled not closer than 2 feet from the missed hole and shall be pointed at such an angle as to eliminate all danger of detonating the old charge. The new hole shall then be charged and detonated.
14. If misfires occur at the end of the shift, they must be reported by the miner to the shift boss, and he in turn shall make a written report of the same for the boss of the on-coming shift.

15. In blasting timber, fuse must be of sufficient length to permit the man lighting it to get to a safe place. In no case shall fuse be less than 3 feet in length.

COMPANY F

In drifting, Company F drift sets vary from 7-foot legs and caps to 10-foot legs and 8-foot caps, depending upon the nature of the ground and the purpose of the drift. In slicing, the legs vary from 5 to 10 feet in length, and the caps are 8 feet. In sublevels and tramming drifts the legs are from 7 to 8 feet and the caps also from 7 to 8 feet. In motor drifts 8-foot legs are used with 7 to 8 foot joggle caps. Hitches are dug for posts, which, after being set in place, are fastened with two bridles of 1/2 by 3 inch by 8 foot iron. The bridles are sometimes of heavier material and are fastened to posts with a track spike. Two layers of 2-inch soft wood planking, or one layer of 2-inch hard wood planking, 18 inches wide, is placed on top of bridles to be used as a staging. The cap is first lifted onto the stage and from the stage it is lifted to the top of the post. Two to four men lift the cap, as the miners are instructed to obtain sufficient help to prevent straining backs. The timber sets are kept within 2 to 3 feet of the working face to protect the men against falls of roof. Sprags are used at the top and bottom of drift sets and between the posts and the side of drifts. Where necessary, forepoles are driven, in advance of sets, while working at the face. This method is used in extremely soft ground. In all cases, however, forepoles are used in advance of the last set and the back is tightly lagged over the forepoles. Wide lagging is also used in advance of the last set whenever the ground shows any inclination to slough off. The timber sets are also tightly wedged. Miners make their own wedges. Care is taken to see that drifts are kept free of all storage materials and débris, except what materials are necessary while work is in progress.

Raises are timbered with cribbing. In 2-compartment raises the cribbing is carried on an average within 4 feet of the back. In loose ground the cribbing is carried right up to the back, while in hard rock the cribbing is carried to within 6 or 7 feet of the back. During the process of raising, ladders are installed for the full length of the cribbing, but after installation the ladders are required to extend 3 feet above the sollar or last platform. A complete raise set is comprised of three cribbing sets, making a height of 7 to 8 feet.

In some mines, due to the nature of the ground, it is seldom necessary to crib raises unless a dike or faulty ground is encountered. These raises are generally 5 by 6 feet and are used for but one purpose, — either as a manway or as an ore chute. When these raises are driven any great distance a parallel raise is made and holed through a 100-foot intervals for safety. This allows the miners, after spitting the fuses, to descend only part way in the raise being driven before finding a place of retreat into the other raise.

The time of blasting varies with the different mines but is usually done from 30 to 10 minutes before going off shift. However, in case of a missed hole or in blasting chunks, and in mines where the smoke clears out quickly, blasting is done at any time during the shift. The miners are supposed to take precautions in counting reports as their holes explode, warn nearby workmen, and guard the approaches to the blast. This precaution is doubly in force when it is expected that a drift or raise will hole through into another opening. Detonators are crimped onto the fuses by the miners in some of the mines, and in other mines crimping is done at a central detonator and fuse magazine using an automatic crimper. A central explosives magazine is used at all mines except one. At this mine a central storage house is used, but the explosive is taken to the working place by the box and stored in special "powder" containers. No explosive is stored within 50 feet of detonators. Explosive is carried in special bags and no man is allowed to carry explosive in addition to detonaor and fuse. The minimum fuse is 4 feet, but as a rule 6-foot fuse is used. The maximum number of holes fired by one man is set at eight, but regardless of the number of fuses spit at one firing, the company requires that not less than two men be present. No detonator less than No. 6 strength is allowed to be used. In wet ground, waterproof fuse is used, and when necessary, electrical blasting is employed. Care is taken to short-circuit the legs of electric detonators and firing lines during the process of loading. From 10 to 14 holes, depending upon the ground, are required to break a drift round. Wooden tamping sticks and powder skewers are provided by the company and used by the men. Whenever it is suspected from counting the reports that a hole has missed fire, the company requires that one hour must elapse before men return to the face just blasted. In some cases, to get more explosive in the bottom of the hole, the miners "shake" a hole with one-half to one stick of explosive before finally charging it, but before this is done, these holes must be tested for temperature.

For fire protection, fire-hose couplings with fire hose attached are provided at all levels. Fire extinguishers are also kept at all levels and manways. In case of fire, gas masks are used for fire fighting, provided that the air is high enough in oxygen to support the flame of a safety lamp. However, if it is found that the air will not warrant the use of gas masks, then oxygen breathing apparatus is placed in service. Air lines are so arranged that water may be turned into them to reach places which can not be reached by the fire hose. The company does not make a practice, however, of daily fire inspection at either surface or underground workings.

COMPANY G

In Company G mines timber is used in all drifting or crosscutting in iron formation or in iron ore where the opening is larger than 4 feet wide and 7 feet high. In drifting or crosscutting in black slates, grey slates, greywacke or ground hard enough to stand without slabbing off, no timber is used. Where the ground is of a nature that is doubtful, timber is used. The back, sides, and breast are trimmed as soon as miners go back after a blast. Where timber is used, the back is blocked at once, employing four or more 8-foot lagging to block ahead. All blasting is done at noon or when the miners go off shift, so that the air may be freed of gases in their absence and to allow for any delay in blasting due to delayed fire.

All raises in ore or in iron formation are cribbed, except in stoping. Raises in black slate or grey slate are not cribbed if the slates are hard and of a suitable nature. Single cribbed raises are 4 by 3 feet, whereas double-cribbed raises are 3 by 9 feet. A safety chain is used in all raises when they are being driven. After the blast, air is blown for a few minutes, then the miner climbs up, fastens the chain across the opening, and trims the back. The chain is down 15 to 20 feet from the back with a large enough mesh to allow the dirt to go through. Eight-foot ladders are used. This allows the men to carry the ladders close enough to the back so that it is not necessary to climb on the cribbing to get up close enough to trim the back. The ladders are set off to one side and raised 4 inches from the cribbing to allow foothold. Ladders are spliced together by laying a 2 inch plank 2 feet long under the ladder and parallel with it. This allows the dirt to go through under the rungs of the ladder and does not interfere with footing when climbing. The other side of the ladder is nailed to the side cribbings. All raises are covered, both the mill and ladder road. All manway raises have doors over the top and gates at the bottom, opening inward; the door over the slide is made of metal strips spaced about 1 inch apart to allow for ventilation.

When blasting in drifts, there are two men to light the fuse. An extra carbide lamp is furnished every gang of miners for use when lighting fuses. In subdrifts one man lights while the other is present; in raises one man lights while his partner waits for him at the bottom of the raise.

In case of fire, the air lines are connected with the water lines so that water can be turned into them. Fire doors are placed on each level in each drift. Fire extinguishers are in readiness in the powder house, pump house, and at the stations on each level. All men are instructed so that they know what do do in case of fire. Maps are placed in the dry house and engine shop which show the location of hydrants and accessories, and also give instructions for procedure in case of fire.

COMPANY H

Company H requires headboards in all timbered drifts. No one is allowed at the breast or along the drift while scraping operations are in effect. Special precautions are taken in handling electrical apparatus. In raising, the company has carefully worked out methods for placing headboards and for side protection and has special instructions for the use of safety belts and staging. In blasting, in addition to ordinary safety precautions, the company requires two primers to be used in all bottom holes. The men are limited as to the number of holes they are allowed to light, and an extra man must be present when blasting is being done. Also, special precautions are taken when one opening is holing through into another.

Considerable care is taken in picking and barring down the back. In all subdrifts and raises, where only a very small amount of timber is used, it is the practice to employ a miner to act as a trimmer, it is his duty to trim all loose rock in the ladder roads and the traveled subdrifts. These places are constantly being inspected by the supervising force and by the company mine inspector. At the working face, or breast, and the territory leading directly to the breast, the miners are held responsible for conditions, especially as to loose ground.

In the open stopes it is required that the method of mining be carried on in such a manner that the miners will not be working or traveling out in the open stope, but will be traveling or working under a back or roof which can be easily reached with a pick or bar so that it is possible to keep loose rock trimmed. Long bars must be used to keep the brow of this back trimmed.

Where the sublevel caving system of stoping is employed, a condition exists similar to that in untimbered raises. The stope is started by working up from the timber with a sloping raise for about three cuts. The stope is kept as small as possible, but during this process it is necessary for miners to go up this raise to trim the loose rock and to do the drilling. In this kind of work considerable care must be practiced in trimming the loose rock. When the raise is up three cuts, it is then enlarged into a stope. Good judgment must be used here so that the back of the stope above the entrance will not be higher than can be reached by the miners in the work of inspecting the back and trimming the loose rock. When the stope becomes large and the back is too high to be reached by the miners, it is necessary to start another manhole to connect with the stope from farther back in the solid. By using such a manhole the miners avoid going into a stope where they can not be sure of the condition of the back. In the sublevel caving system of stoping much care must be exercised with relation to loose rock, especially in faulted ground and ground traversed by dikes.

In timbered main-level drifts and crosscuts, subdrifts, and sublevel crosscuts, the timber is kept right up to the breast. The miners must go beyond the timber, after the blast, to trim the loose rock, which is done with picks and bars. The back must be well trimmed before headboards can be put up. After the headboards are in place, it is fairly often necessary to use blocking between the headboards and the back. It is also necessary to inspect the back after the headboards are in place to see that it has been properly blocked. It is necessary to trim and inspect the sides and breasts of drifts and crosscuts fairly often during the shift.

There is frequently a distance of 1 or 2 feet beyond the timber where headboards can not be used because the back is too low. In this case it is the practice to use longer drills for starting holes so that the miners, when drilling, will not be compelled to go out beyond the timber to complete their cuts.

In sounding the back for loose ground the miners are continually cautioned to be careful not to sound the back directly over their heads, but to sound it ahead of where they are standing.

In all main-level drifting and crosscutting in rock it is the practice either to gunite or to timber. The guniting as the drift or crosscut advances must be done at regular intervals and must be kept as near as practicable to the breast. From the point where the gunite is left off up to the breast it is the duty of the miners to keep the loose material trimmed and make frequent inspections of the back and sides for loose ground. In addition to the miners' inspections, these openings are being inspected for loose ground every day by the supervising force and the mine inspector. When the gunite spalls off, it is immediately re-gunited or timbered.

Provision is made for putting water into the air lines for fire fighting. Fire hose is kept available at a number of places underground. Fire extinguishers are placed at readily accessible points. Men are drilled in the use of fire-fighting equipment underground, and each shaft is equipped with an ethyl mercaptan warning stench. It has not been the custom to make a fire run every day.